PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improvements in Ironless Induction Furnaces.

We, HIRSCH, KUPFER- UND MESSINGWERKE AKTIENGESELLSCHAFT, a body corporate organised under the Laws of Germany, of Messingwerk, near Eberswalde, Germany, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The present invention relates to an electric ironless induction furnace for melting or heating metals and ores. The electric ironless induction crucible furnaces which up to the present time have been employed for melting or heating metals and ores are generally worked with currents of high frequency and on that account are called high frequency furnaces. A furnace of this type consists essentially in a crucible which is surrounded externally by an air or water cooled coil. For the production of the current of high frequency a converter unit is necessary comprising, for example, a motor and a high frequency generator. If a polyphase motor is used it may be connected to a polyphase supply system. It has been found that it is economically advantageous to work such furnaces with currents of normal frequency (50 to 60 cycles per second). It has also been proposed to work such furnaces with frequencies of $2 \times 50 = 100$ or $3 \times 50 = 150$ cycles per second. Since with ironless induction crucible furnaces a converter unit is not required if the normal frequency is used, the coil has in some cases been connected to one phase of a polyphase current supply. In this way the polyphase current installation is disadvantageously loaded, which leads, particularly with the single phase connection of furnaces of large output, to increased losses in the installation.

According to the present invention, the inductor windings are divided into two separate coils energised from different phases of a polyphase circuit of low frequency and surrounding respectively the upper and lower portions of the furnace, the coils being preferably connected to a phase transformer circuit of known type. The arrangement according to the invention has the advantage that, at normal full power input, the phases of the polyphase system are not unequally loaded.

In an embodiment which will be explained later the two coils are connected together in Scott's method for changing three-phase into two-phase circuits. The two coils are magnetically separated by two iron rings composed of sheet iron discs insulated from one another. Between the iron rings there is an air space or a layer of a non-magnetic material.

The field of the upper circuit is closed externally through the upper iron ring and the field of the lower circuit through the lower iron ring. The air space between these two iron rings is practically free from lines of force. The magnetic fields of the upper and lower circuit and of the currents flowing in the melting bath which are relatively displaced in Scott's circuit system by 90°, are still more completely separated if the diameter of the lower part of the furnace is smaller than that of the upper furnace. By this arrangement the magnetic screening action of the two iron rings is increased, since they exert a screening action both at right angles and also parallel to the central axis. The diameter of the iron rings may also be less than that of the lower coil, whereby the screening action of the iron rings is still further increased. This is, however, not absolutely necessary; since the secondary currents only flow at the periphery of the bath, the fields produced are therefore concentrated mainly at the periphery of the bath near the iron rings and towards the centre of the bath are considerably reduced.

By tappings arranged at one or other of both coils the output can be controlled. For example, during the refining period in which less power is required, the upper coil can be cut off by a switch, the lower coil alone remaining in circuit. Phase compensation can be obtained, as in high frequency furnaces, by condensers if the conditions require it.

In the accompanying drawing an example of a furnace according to the invention is shown diagrammatically.

A represents in section a crucible sur-

[*Price* 1/-]

rounded by two coils B and C of copper strip or copper tube. The two coils are connected together in Scott's circuit system. Between the two coils B and C are the two rings D and E which are made of transformer sheet iron and are preferably separated from one another by distance pieces of non-magnetic material. Between the crucible A and the coils B and C there are a heat insulating layer G and a cylinder H of electric insulating material. The same electric insulating material can also be used to separate the coil windings. Also, the intermediate layers between the coils and the iron rings or between the coils and the coil clamping devices can also be made of the same material shown at H[1]. The furnace is covered by a cover I of refractory material such as firebrick or the like. The base K can be made of the same material. The cover rests on annular segments L. The furnace is tipped about an axle M which is below the pouring spout. The two coils are connected to the polyphase current leads by a three-pole switch N. The lower coil can be wholly or partially connected by the switch O, in order to adjust the power supplied to the furnace. The upper coil is inserted by the switch P.

The title "ironless induction furnace" is selected for the subject of the invention, although strictly speaking one portion of the magnetic path consists of iron. But there is no other title for such furnaces in use at the present time and, therefore, this expression, usually applied to high frequency furnaces, is retained.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. An ironless induction furnace in which the inductor windings are divided into two separate coils energised from different phases of a polyphase circuit, of low frequency and surrounding, respectively, the upper and lower portions of the furnace.

2. An ironless induction furnace, according to Claim 1, in which the two coils are connected to a phase transformer circuit of known type.

3. An ironless induction furnace according to Claim 1 or Claim 2, in which rings of insulated sheet iron are placed between the two coils and are separated from one another by an air space or by a non-magnetic material.

4. An ironless induction furnace according to any of the preceding claims, in which for the purpose described the lower part of the furnace has a smaller diameter than the upper part.

5. An ironless induction furnace according to any of the preceding claims, in which the different coils or parts of the coils can be cut out as required in order to control the input of power.

Dated this 6th day of September, 1928.

ABEL & IMRAY,
30, Southampton Buildings, London,
W.C. 2,
Agents for the Applicants.

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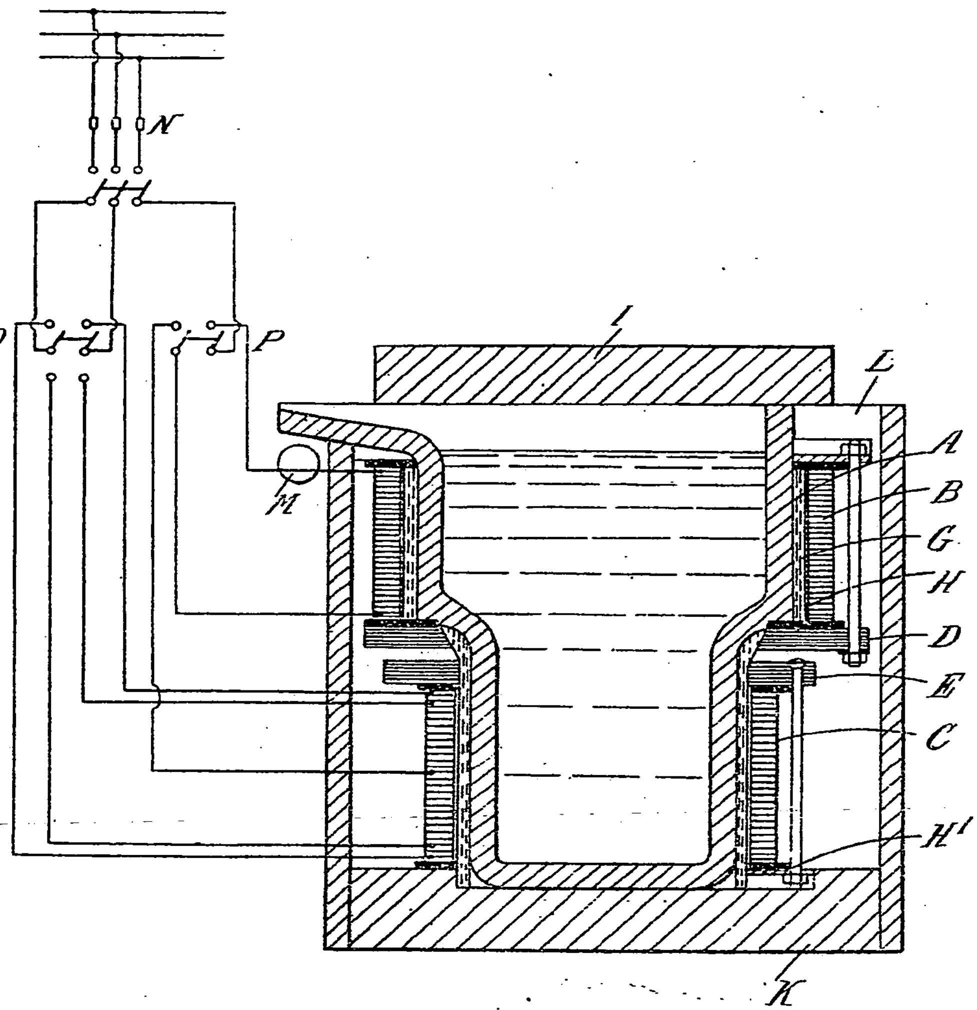

[This Drawing is a reproduction of the Original on a reduced scale]

Charles & Read Ltd. Photo Litho.